19/C4 52

murphy

RADIO LTD

ELECTRONICS DIVISION

WELWYN GARDEN CITY • • ENGLAND

INSTRUCTION MANUAL

for

A FIELD STRENGTH MEASURING SET

MP MASTER

MA23732

The Patent 'LOXON' Loose-leaf BINDER

Patent No. 364810

OXFORD SERIES

LIST OF STANDARD SIZES

Ref. No.	Size of Leaf
51	8 x 6½
52	9¼ x 7⅛
53	10¼ x 8
55	13 x 8

Reference for re-ordering

53 D

HOW TO USE THIS BINDER

1.—To insert or withdraw leaves, open the Binder at the place where the leaves are to be inserted or withdrawn, then draw the two sets of spear and sheath tags through to this piece and disjoin.

2.—Insert or withdraw the leaves and join the laces up again.

3.—Draw the laces tight and wind up under the spiral springs.

HUNT & BROADHURST Ltd., OXFORD

DIST. DWRI D2 CRN LAB. | LOCATION DWRI D2

INSTRUCTION MANUAL FOR THE FIELD STRENGTH MEASURING SET TYPE FSM22A.

105/CM 93

CONTENTS

Section	Title	Page
1.	General Information & Specification	1.
2.	Controls & Connections	4.
3.	Operating Instructions	8.
4.	Circuit Description	14.
5.	Mechanical Details	18.
6.	Valve Details	21.
7.	Test Information, Alignment, etc.	22.
8.	Layout Diagrams, R. F. Unit	
	I. F. Unit	
	Front Panel	
	Power Unit	
	Etc.	
9.	Circuit Diagrams, R. F. Unit & Front Panel	YE514247
	I. F. Unit	YE514248
	Power Unit type P23	YE508664

------oOOoo------

SECTION 1. GENERAL INFORMATION AND SPECIFICATION.

1. The FSM22A has been developed to meet the growing need for equipment to measure interference voltages from electrical appliances, car ignition systems and other sources, in the 30 - 150 Mc/s range of frequencies.

2. In addition to noise measurements, the FSM22A may be used to compare the performance of small or large transmitters, aerials, feeder systems, wave filters, and for general use as a sensitive r.f. voltmeter. It may also be used as a general purpose monitoring or communications receiver.

3. The equipment may be operated from a 200 - 250 volt, 50 c/s supply for laboratory use, or from a 6 volt battery for mobile purposes.

4. The complete equipment comprises the following items:-

(a) The Receiver type FSM22A, containing the r.f. unit, i.f. unit, attenuators, meter, etc., together with case and front lid and spare aerial plug.

(b) The Power Unit type P23, containing the power supply circuits for the receiver FSM22A, together with case and front lid.

(c) The Aerial System, consisting of a tripod, a dipole aerial unit with extension rods to cover the different frequency ranges of the receiver, a broadband Balun (balance to unbalance transformer) and an aerial carrying case for the complete aerial system.

(d) Two Calibration Charts, for terminal voltage and field strength measurements and Instruction Manual.

(e) All the necessary inter-unit, power and aerial cables.

Cont'd...2

5. Performance Specification.

Frequency Coverage:	Band 1. 30 - 42 Mc/s Band 2. 41 - 57.5 Mc/s Band 3. 57.5 - 80 Mc/s Band 4. 80 - 111 Mc/s Band 5. 111 - 150 Mc/s
Intermediate Frequency:	10 Mc/s.
Sensitivity:	Between 3 and 6 uV across 75 ohms for 15 dB signal to noise ratio.
Attenuation:	Maximum r.f. and i.f. attenuation totals 105 dB.
Voltage Measurement Range:	Approximately 5uV to 1V c.w.; measurement can be made down to about 1 uV with reduced accuracy.
Peak Signal Capacity:	36 dB above c.w. level.
Detector Time Constant:	Charge TC: 1 mS, ± 10%. Dischange TC: 500 mS, ± 10%.
Bandwidth:	Greater than ± 22.5 Kc/s at 1.5 dB down. ± (45 - 55)Kc/s at 6 dB down. ± 100 Kc/s at 20 dB down. ± 200 Kc/s at 60 dB down.
Image Rejection:	> 40 dB at frequencies between 30 - 75 Mc/s. > 35 dB at frequencies between 75 - 150 Mc/s.
I.F.Rejection:	Greater than 75 dB.
Attenuator:	Maximum error of course attenuator : 2 dB Maximum error of fine attenuator: 1 dB

Cont'd...3

5. Performance Specification (Continued)

Power Consumption:	Mains: 65 watts at 230 volts, 50 c/s. Battery: 11 amps at 6 volts, 4 amps at 6 volts when the h.t. supply to the receiver is switched off.
Weight:	FSM22A Receiver: 39 lbs. Case 52½ lbs. P23 Power Unit: 32½ lbs. Case 42½ lbs. Aerials etc. in case: 17½ lbs.
Overall Dimensions:	FSM22A Receiver: 19¾" x 14½" x 11¼". P23 Power Unit: 17" x 11⅞" x 10". Aerial Case: 47" x 5¾" x 12".
Manufacturer:	Murphy Radio Limited, Electronics Division, Welwyn Garden City, Herts, England. Telephone: Welwyn Garden 800. Cables: Radmurphy, London.

RECEIVER 39 lbs. CASE 52½ lbs. TOTAL 91½ lbs. SIZE 27" X 19" X 22 ins. deep

POWER UNIT 32½lbs. CASE 42½ lbs. TOTAL 75 lbs. " 17" X ~~25~~ 25" X 18 ins. deep

AERIALS IN CASE 17½ lbs. SIZE 4 ft. X 1 ft. X 5½ ins. deep

MEASUREMENTS OVERALL.

SECTION 2. CONTROLS AND CONNECTORS.

1. Receiver Unit type FSM22A.

a) RANGE SELECTOR: Any one of the five frequency bands may be selected with this control. (See page 2.)

b) TUNING: This control is provided with a directly calibrated scale; a small spring loaded handle is fitted to the control knob to facilitate rapid changes of frequency.

c) AERIAL TRIMMER: This control is supplementary to the main tuning control, and is adjusted for maximum output.

d) COARSE ATTENUATOR: Varying degrees of attenuation (0dB to 80dB, in 20dB steps) may be switched in with this control. In addition, the signal input to the r.f. stages is removed ("Cal" position) so that first stage noise may be used as a reference level, and in the "Set Zero" position, the i.f. stages are disconnected to provide "no signal input" conditions, thus enabling the meter zero adjustments to be carried out.

e) FINE ATTENUATOR: This control will provide up to 25 dB, continuously variable i.f. attenuation. The total attenuation thus available using both fine and coarse attenuators is 80 + 25 = 105 dB.

f) L.S. ON-OFF SWITCH: This switch is in the monitor loudspeaker circuit; the loudspeaker is muted when this switch is in the OFF position.

g) AUDIO GAIN: As its name implies, this control varies the gain of the a.f. stages only. It has no effect on the meter sensitivity.

Cont'd...5

1. Receiver Unit Continued (Controls and Connectors)

h) AVC/MOD SWITCH: This control has three positions: "AVC On", "Off" and "Mod On". For measuring purposes this control is set to "Off", for searching or listening to modulated signals the "AVC On" position may be used; and the "Mod" position is used for c.w. reception. In these two latter positions the set cannot be used for measurements, and the meter is connected to give an indication of the receiver h.t. volts.

i) CAL. (Calibration): This control determines the i.f. gain of the receiver. It is used to set the overall receiver gain to a standard value, see Operating Instructions, Section 3.

j) SET ZERO: With the coarse attenuator switched to "Set Zero", the "Set Zero" control is adjusted to obtain a left hand zero reading on the meter (i.e. no current passing through the meter).

k) METER: For measurement purposes the signal input to the receiver is attenuated so that a constant meter reading is obtained. There are two settings marked on the meter scale, viz: "0dB" with its ± ½dB patch, and a red patch showing the permissable tolerance in the h.t. voltage. The meter is automatically switched by the AVC/MOD control.

l) AERIAL: The short co-axial lead from the Balun transformer is plugged into this socket. Alternatively, a co-axial lead from any other sourse may be plugged into this socket.

m) POWER SUPPLY IN: The power lead providing both h.t. and l.t. from the Power Unit, is connected to this plug.

Cont'd...6

2. Power Unit (Controls and Connectors)

a) MAINS/OFF/BATT SWITCH: This control has four positions: "Batt", "Off", "Mains" and "Off. When it is turned to "Batt", the heaters of the receiver valves are directly connected to the battery supply, and a rotary transformer provides the h.t. In the "Mains" position, conventional circuits provide the heater and h.t. supplies. Indicator lamps show whether a battery or a main supply is in use. In the "Off" positions, the equipment is entirely disconnected from both battery and mains supplies.

b) H.T. ON-OFF SWITCH: The complete receiver may be muted ("Stand-by" condition) with this switch which will disconnect the h.t. supply to the receiver. When the receiver is working from batteries but is not actually in use, switch off the h.t., as this will provide an appreciable reduction in battery consumption (See Specification).

c) MAINS VOLTAGE SELECTOR: This control should be set to the appropriate voltage for the mains supply at the Power Unit input; a rough check that this control is correctly set is provided by the h.t. indication on the meter in the Receiver Unit.

d) FUSES: Three fuses are provided in the Power Unit; they are as follows:-
500 mA., h.t. supply to Receiver.
2 A., mains input to Power Unit.
25 A., battery input to Power Unit.
Three spare fuses are provided in the panel below the lead compartment at the side of the Power Unit.

Cont'd...7

2. Power Unit Continued (Controls and Connectors).

e) POWER SUPPLY OUT: The power lead to the Receiver is connected here.

f) THREE CORE FLEXIBLE CABLE: This is the mains input lead; the red and black cores are the live and neutral connections and the green core is earthed.

g) GREEN LEAD: This lead, which is terminated with a large spring clip, is the negative connection for the 6 volt battery supply.

h) RED LEAD: This lead is also terminated with a large spring clip, and is the positive connection for the 6 volt supply.

NOTE: When the battery leads are in use, the mains lead is completely disconnected from the remainder of the equipment and may be coiled up in the lead compartment. Similarly, when the mains lead is in use, the battery leads are not connected internally, and may be coiled up in the lead compartment.

---------ooOoo---------

Cont'd...8

SECTION 3. OPERATING INSTRUCTIONS

1. Note on Calibration

Initial calibration of the FSM22A is carried out at the factory by reference to a signal generator or noise source, and from this calibration the calibration charts supplied are calculated. If desired, a periodic check of the calibration may be made by following the instructions given in Section 7, pages 22 to 27.

2. Both in initial calibration and in use, the FSM22A is set to have a standard gain by using the noise from the first circuit (and from the first valve at the higher frequencies) as a reference source. This is done by adjusting the CAL (Calibration) control so that this noise gives OdB reading on the meter; this procedure compensates for any changes of gain in all stages following the first stage of the receiver. Changes of gain or of the noise level of the first stage is very unlikely, and can only be due to failure of the r.f. amplifier (V1) or by extreme misalignment of the first circuit. Either of these faults will be shown by the absence of any change in noise output as the AERIAL TRIMMER is adjusted; normally at least 1dB change of noise output is obtainable on all bands, and about 3dB change on the lower frequency bands. It will be seen therefore, that use of the first stage noise as a ref - erence signal ensures that the set will operate under standard conditions at all times.

3. Control Functions

The function of each of the controls is described in Section 2, but the following notes cover the normal operation procedures.

4. Operating Procedure - See next page.

4. Operating Procedure.

The general procedure, detailed below, is the same for all types of measurement, but the methods of connection of the signal input, and the instructions for the interpretation of the results are given in the paragraphs following the heading "Methods of Measurement", on page 13. It is important that the sequence of adjustments described should be followed if accurate results are to be obtained.

a) CONNECTIONS: Connect the FSM22A to its Power Unit by means of the cable provided.

Connect the Power Unit either to a 200-250V 50c/s a.c. supply, or to a heavy duty 6V accumulator (see page 6). Adjust MAINS VOLTAGE selector if necessary. If the exact mains voltage is not known, set to highest voltage position.

Connect the signal to be measured to the Aerial Socket, as described under "Methods of Measurement".

b) TO SWITCH ON: Set the MAIN SWITCH on the Power Unit to "Mains" or "Battery" as applicable. Set the H.T.ON-OFF switch on the Power Unit to "On". Allow a few minutes for the equipment to warm up.

Set the AVC/MOD switch to "AVC ON" and check that the meter reading (which now indicates the h.t. voltage) is within the red patch on the scale; if the exact main voltage is not known, adjust the MAINS VOLTAGE selector on the Power Unit until the meter indication is within the red patch.

When on battery operation set the H.T.ON-OFF switch on the Power Unit to "Off" during periods between measurements.

c) INITIAL CONTROL SETTINGS:

Coarse Attenuator:	"Set Zero"
Fine Attenuator:	"0dB"
Cal. (Calibration):	midway position

Cont'd...10

4. Operating Procedure (Continued)

c) INITIAL CONTROL SETTINGS: Cont'd.

AVC/Mod Switch:	"Off" (Cental position)
Band Selector:	to frequency desired
Tuning:	to frequency desired
Aerial Trimmer:	"5"
L.S.On-Off Switch:	as desired
Audio Gain:	as desired

d) TO ZERO THE METER: With the controls set as above, adjust the SET ZERO control to bring the meter pointer to the left-hand end of the scale. Although very little drift of the meter zero will occur, this operation will probably need to be performed once again after warming up.

e) TO STANDARDISE GAIN: Ensure that the BAND SELECTOR and the TUNING controls are set to the frequency desired. Set the FINE ATTENUATOR to "0dB" and the COARSE ATTENUATOR to "Cal"; adjust the CAL control until the meter reading due to noise is approximately 0dB. Adjust the AERIAL TRIMMER to obtain a maximum reading on the meter (1 - 3dB variation should be obtainable as the AERIAL TRIMMER is rotated); now adjust the CAL control until the meter reads 0dB. Do not then disturb the setting of the CAL control.

N.B. If the signal to be measured is very strong, it is advisable to dis - connect the signal input when carrying out the gain standardisation procedure, especially at the higher frequencies; the attenuation of the COARSE ATTENUATOR at the "Cal" position is limited by leakage inside the attenuator to about 90 or 100 dB; this slight leakage will not cause errors during measurement, since the maximum r.f. attenuation given during measurement is only 70 dB.

Cont'd...11

4. Operating Procedure (Continued)

f) TO MEASURE A SIGNAL: Set the COARSE ATTENUATOR to "0dB" and rock the TUNING control until the signal is received. Adjust the COARSE and FINE ATTENUATORS until the meter reading is "0dB", adjusting the TUNING and AERIAL TRIMMER controls to obtain maximum signal strength.

g) USE OF LISTENING FACILITIES: The internal loudspeaker may be used at will by operation of the L.S. ON-OFF switch, when the volume may be controlled by the AUDIO GAIN control: this does not affect the metering circuits. If headphones are to be used, these should be of a high impedance (2000 ohms) type. The headphone outlets are adequately filtered and there is no need to remove the headphone leads when taking measurements.

For listening to unmodulated signals, the AVC/MOD SWITCH should be set to "Mod-On"; in this position the signal is internally modulated by a 1000 c/s tone.

If an aural search for modulated signals is to be made, the AVC/MOD SWITCH should be set to "AVC-On"; this will prevent the audio stages (and the user's ears) being overloaded by unexpectedly tuning to a strong signal.

5. Methods of Measurement

The previous paragraphs describe the use of the controls of the FSM22A, and the operating procedure. In the following paragraphs, the methods of connecting the signal input to the set, and the methods of interpreting the results are described.

Cont'd...12

5. Methods of Measurement (Continued)

a) FIELD STRENGTH MEASUREMENTS: Place the aerial tripod in a suitable position and fix the wooden extension to the top of the tripod. Screw the corrent aerial extension rods into the dipole aerial, as shown in the table below.

Band	Extension Rod	Total Length
1	Long	117" approx.
2	Long	117" approx.
3	Medium	83" approx.
4	Short	61" approx.
5	None	43" approx.

With the extension rods fitted as shown, the aerial is then resonant at the mid-frequency of the band in use (except on Band 1).

Connect one end of the twin feeder to the dipole housing and mount the housing on to the tripod and rod support; the aerial may be placed vertically or horizontally as desired. Connect the other end of the twin feeder to the Balun (balance to unbalance transformer) which may be clipped to the left-hand front panel handle of the FSM22A. Connect the Balun to the AERIAL socket of the FSM22A by means of the short co-axial cable provided.

Measure the signal level as detailed in paragraphs (4.b) - (4.f) above and note the attenuator readings. Refer to the FIELD STRENGTH CALIBRATION CHART, and note the correction factor K_f given on the chart for the frequency concerned; add this factor to the attenuator reading - the sum is then the: field strength at the aerial, given in dB's above 1 uV/metre.

N.B. The insertion loss of the Balun transformer is included in the factor K_f given.

Cont'd...13

5. Methods of Measurement (Continued)

b) UNBALANCED TERMINAL VOLTAGES: Connect the source of signals to the AERIAL Socket via a length of co-axial cable; the impedance of the source should be transformed or padded to 75 ohms.

Measure the signal level as described in paragraphs (4.b) - (4.f) above, and note the attenuator readings. Refer to the TERMINAL VOLTAGE CALIBRATION CHART, and note the correction factor K_v given on the chart for the frequency concerned; add this to the attenuator readings, the sum is then the terminal voltage between the aerial socket of the FSM22A and earth given in dB's above 1 uV.

c) BALANCED TERMINAL VOLTAGES: Connect the source of signal to the twin inlet of the Balun transformer via a length of twin cable; the impedance of the source should be transformed or padded to 75 ohms. Connect the Balun to the Aerial socket of the FSM22A.

Measure the signal level as described in paragraphs (4.b) - (4.f) above and note the attenuator readings. Refer to TERMINAL VOLTAGE CORRECTION CHART and note the correction factor K_v given on the chart for the frequency concerned and add this to the attenuator reading. To take into account the slight insertion loss of the Balun transformer, add 1 dB to the total; this result gives the terminal voltage across the balanced input of the Balun in dB's above 1 uV.

---------ooOoo---------

Cont'd...14

SECTION 4. CIRCUIT DESCRIPTION

1. The R.F.Unit

This separately screened unit contains the r.f. amplifier, frequency-changer, and the local oscillator stages. The frequency coverage of 30-150 Mc/s is obtained in 5 bands, ganged tuning being employed, supplemented by an aerial circuit trimmer. The input from the r.f. attenuator is auto-transformer coupled to the first tuned circuit. As this circuit forms the termination for the r.f. attenuator, a resistive network is interposed in order to minimise variations of input impedance as the circuit impedance varies with frequency. A high slope r.f. pentode (V1, type 6F12) is used as the first r.f. amplifier, and the gain obtained is sufficient to ensure that the only important sources of noise are the first circuit and the r.f. amplifier itself.

2. A second r.f. pentode (V2, type 6F12) is used as a frequency changer. the grid being connected to the tuned circuit which forms the r.f. amplifier load. The anode load of the frequency changer consists of an i.f. transformer tuned to 10 Mc/s. Cathode injection of the local heterodyne voltage is used as this gives a minimum of interaction between the signal and oscillator circuits.

3. The local oscillator stage employs a double triode valve (V3, type ECC91) with both sections in parallel, connected in a Colpitt's circuit. The local oscillator frequency is 10 Mc/s higher than the signal frequency on the four lower frequency bands, but is 10 Mc/s below the signal frequency on the highest frequency band. The circuit is so arranged that the heterodyne voltage at the frequency changer is substantially constant at all frequencies.

4. A single i.f. amplifier follows the frequency changer, another high slope r.f. pentode (V4, type 6F12) being used. The anode load of this stage is an i.f. transformer with a low impedance secondary which feeds the i.f. attenuator.

Cont'd...15

5. The Attenuator Unit.

This consists of a coarse r.f. attenuator ganged with a one section i.f. attenuator, and an i.f. attenuator with a continuously variable control.

6. The r.f. signal input socket forms part of the r.f. attenuator, which is a 75 ohms unbalanced ladder network. The maximum total r.f. attenuation is 70 dBs. The output from the coarse r.f. attenuator is fed to the r.f. unit mentioned above.

7. The coarse i.f. attenuator is a 75 ohms unbalanced network, which is inserted in the link between the R.F. Unit and the I.F. Unit.

8. The fine attenuator, a 75 ohms slide wire giving 0 - 25 dBs continuously variable attenuation, is connected in series with the coarse i.f. attenuator. The signal output from the i.f. attenuators is taken to a low impedance input on the i.f. unit.

9. Operation of the coarse attenuator inserts 10 dBs of r.f. attenuation and 10 dBs of i.f. attenuation in the "20 dB" position, and then provides three further 20 dB steps of r.f. attenuation. In the "0dB" position, no attenuation (either r.f. or i.f.) is inserted, the receiver operating at full gain. In the "Cal" position, no i.f. attenuation is inserted, but the aerial input to the r.f. unit is disconnected so that first circuit and first stage noise alone provides the signal which is used for gain standardisation. The "Set Zero" position breaks both the r.f. and i.f. paths so that the indicating meter can be zeroed under "no signal" conditions.

10. The I.F.Unit

After impedance transformation, the i.f. signal is fed to two stages of i.f. amplification using variable-mu r.f. pentodes (V11 and V13, types EF92). The gain of these stages may be varied to provide gain standardisation (CAL Control). When auralsearching and listening is being carried out, a.g.c. may be applied (AVC/MOD Control, "AVC" position). To assist in the detection of c.w. signals, the first stage may be amplitude modulated by a locally generated 1000 c/s tone (AVC/MOD Control, "Mod" position).

Cont'd...16

11. A low slope r.f. pentode (V12, type EF92) is connected in an r.c. oscillator circuit to provide the a.f. modulating signal for the first i.f. stage in the I.F.Unit. The output from this oscillator is normally short circuited but when AVC-MOD Switch is at "Mod-On", the a.f. output is connected to the suppressor grid of V11, negative bias for this grid being obtained from the rectified output from the oscillator.

12. The final i.f. amplifier (V14 and V15, types 6F12) consisting of a push-pull stage using high slope r.f. pentodes, has a very high peak signal handling capacity. The detector is designed to have good low level linearity with high peak signal handling capacity, and has standardised peak reading time constants; it consists of one half of V16 (type EB91).

13. A stable balanced d.c. amplifier follows the detector stage and consists of the double triode V17, type 12AT7. The output current of this d.c. amplifier is linear up to 4 times the normal level, after which it is limited so that it does not exceed four times the meter full scale deflection current. The other half of V16 is connected to V17 so as to reduce the effect of contact potential changes in V16. A moving coil meter, the time constant of which is standardised, is connected between the anodes of the double triode, means being provided to adjust the circuit so that the meter may be zeroed.

14. For audio and a.g.c. purposes an additional detector (Germanium crystal W4, type CG4C) is provided, and this is followed by an a.f. amplifier (V18, type EF92) and an output pentode (V19, type EL91), feeding the 2½ inch monitor loudspeaker and the headphone outlets. When the monitor loudspeaker is not required, it may be switched out of circuit, the load resistor R71 being connected in its place.

15. <u>The Power Unit.</u>

This unit provides the 6 volt heater and the h.t. supplies for the Receiver. When used on 50 c/s mains, a conventional full wave rectifier circuit is used employing a UU6 valve. A 6 volt rotary transformer supplies the h.t. when the equipment is operated from a 6 volt d.c. source. Adequate filtering and smoothing circuits are also incorporated in this unit, the h.t. filtering being common for both battery and mains input supplies. Provision is made for switching off the h.t. supply to the

Cont'd...17

15. The Power Unit (Continued).

receiver; on battery operation this also switches off the rotary transformer. Fuses are incorporated in the h.t. output, and in both the mains and battery input leads.

---------ooOoo---------

Cont'd...18

SECTION 5. MECHANICAL DETAILS.

1. For the purpose of this description, the Receiver Unit is divided into three main items, and these are respectively:- The R.F.Unit, the I.F.Unit, and the Front Panel.

2. The diagram of the rear view of the Receiver shows the two units attached to the front panel; in both cases the side plates project forward in order that the units may be clear of the smaller items mounted on the front panel itself. The upper chassis is the R.F.Unit; it is completely screened, and contains all the components within the dotted lines on the circuit diagram YE514247. The chassis of the I.F.Unit is mounted at an angle in order to improve accessibility. The r.f. and i.f. attenuators and the chain drive which gangs them together, the filter boxes with power and phone connectors, the loudspeaker etc., are all mounted direct on the front panel. The three units are connected together by means of suitable plugs and sockets, details of which are given on the circuit diagram YE514247 and in paragraph 11 below.

3. The R.F.Unit chassis and case are insulated from the I.F.Unit and the front panel to ensure satisfactory screening, the only earth connections being through the co-axial input lead from the attenuator switch box, and the four way miniature power plug. The output lead from the R.F.Unit is not earthed except at the input to the i.f. attenuator.

4. The screening cover which is fitted around the R.F.Unit can be removed if desired by unscrewing the 6BA securing screws. Some of these along the edge nearest to the i.f. unit will be most easily removed by means of a very short screwdriver.

5. Three separate variable capacitors are ganged together for tuning, the oscillator having a split stator, and they are rotated by means of a worm drive and an anti-backlash gear wheel. The tuning scale is driven from the mains tuning control shaft by a small pinion, back-lash in the scale being taken up by an additional spring loaded gear train. If any part of the tuning mechanism is dismantled for servicing etc., care should be taken upon re-assembly that all screws are tight and that the three capacitors are correctly aligned with respect to the scale (i.e. when the vanes are fully in mesh, the engraved line at the lowest frequency end of the scale should co-incide with the cursor).

Cont'd...19

6. The range switch is also driven through a train of gears which provide a 2:1 step down. The switch "click" or locating mechanism is fitted to the end plate of the r.f. unit. If any part of this assembly is dismantled, it must be ensured, on re-assembly, that the switch contacts bring the lowest frequency coils into circuit when the control knob is in position 1.

7. All the range switch wafers, and the ganged capacitors are coupled together through insulated couplings to prevent interstage feedback. The sections of the switch shaft are individually earthed by means of springs fitted to the interstage screens, which also support the switch wafers, coils and trimmers.

8. Both the R.F.Unit and the I.F.Unit are easily detachable from the Front Panel, the only points to bear in mind being the position of the control knobs, and the insulation of the r.f. unit chassis. In addition, the four controls, CAL, AVC/MOD, METER ZERO, and AUDIO GAIN, are attached to the I.F. Unit, and the control knobs must therefore be removed before detaching this unit from the front panel.

9. The R.F. and I.F. sections of the coarse attenuator are ganged together with a chain drive. When replacing this after removal, set both attenuators to the "Set Zero" position - this is easily located by the "click" mechanism on the r.f. attenuator, and by the position of the earthed tag on the i.f. attenuator (remove the cover of the i.f. attenuator box). Make sure that the grub screws on the chain drive wheels are tight. Finally, after replacement, fit the control knob, also in the "Set Zero" position, and check the operation of this control.

10. Where possible, all components are marked to correspond with the code numbers on the circuit diagrams, and no difficulty should be experienced in locating them. Layout diagrams have, however, been included at the rear of this manual.

11. Inter-unit Connections

The inter-unit connections are clearly shown in the circuit diagrams, but the information contained in the table

Cont'd...20

11. Inter-unit Connection Continued

below may be useful.

FROM	Connector	TO	Connector
Front Panel	Aerial Socket	R.F.Atten.	Part of Assembly
R.F.Atten.	Co-ax.socket	Switch box	Co-ax. lead on box
Switch Box	Co-ax.socket	R.F.Unit	Co-ax. lead on R.F. Unit
R.F.Unit	Co-ax. lead	I.F.Atten.	Co-ax. socket
I.F.Atten.	Co-ax.socket	I.F.Unit	Co-ax. lead on I.F. Unit
Front Panel	4-way socket	R.F.Unit	4-way plug on cableform
Front Panel	8-way socket	I.F.Unit	8-way plug on cableform
Aerial Skt.		Balun	Short double ended co-axial lead
Balun	2-way socket	Aerial System	Twin Aerial Feeder
Receiver	Power Plug	Power Unit Output	Heavy 3-way screened connecting cable.
Power Unit	Black 3-way	Mains Supply	Alternative power supply source connectors
	Red and Green	Battery Supply	

---------ooOoo---------

Cont'd...21

SECTION 6. VALVE DETAILS

1. General

With the exception of the rectifier valve in the Power Unit (UU6 British Octal Base) all the valves used in this equipment are of the all-glass miniature type. Handle these valves carefully, especially when removing or fitting them in their valve holders; the pins are easily bent, in consequence the glass seal may be damaged and it is recommended that a valve extractor (B76 type) is used to remove them when this is necessary.

2. Valve positions and pin connections

Valve Number	Type	C.V. Type	Position	Pin Connections 1	2	3	4	5	6	7	8	9
1	6F12 or EF91	CV138	R.F.Amp.	G1	K	H	H	A	G3/S	G2	-	-
2	"	"	F.C.	G2	K	H	H	A	G3/S	G2	-	-
3	ECC91	CV858	Osc.	A_1	A_2	H	H	G2	G1	K	-	-
4	6F12 or EF91	CV138	1st I.F.	G1	K	H	H	A	G3/S	G2	-	-
11	EF92	CV131	2nd I.F.	G1	K	H	H	A	G3/S	G2	-	-
12	EF92	CV131	Mod.Osc.	G1	K	H	H	A	G3/S	G2	-	-
13	EF92	CV131	3rd I.F.	G1	K	H	H	A	G3/S	G2	-	-
14	6F12 or EF91	CV138	4th I.F.	G1	K	H	H	A	G3/S	G2	-	-
15	"	"	" "	G1	K	H	H	A	G3/S	G2	-	-
16	6D2 or EB91	CV140	Met.det.	K_a	A_b	H	H	K_b	s	A_a	-	-
17	12AT7	CV455	D.C.amp	A_b	G_b	K_b	H	H	A_a	G_a	K_a	H_{ct}
18	EF92	CV131	A.F.amp	G1	K	H	H	A	G3/S	G2	-	-
19	EL91	CV136	A.F.out	G1K/G3		H	H	A	nc	G2	-	-
-	UU6		Rect.	H/K	nc	A_a	nc	A_a	M	H	-	-

(nc:- no connection)

Cont'd...22

SECTION 7. TEST INFORMATION, ALIGNMENT, PROCEDURE & TEST FIGURES

1. Alignment, Important Note.

Under normal circumstances, it is recommended that this equipment be returned to Murphy Radio Limited for re-alignment if it becomes necessary, since it is very important that this operation is carried out accurately in conjunction with high quality test gear. If, however, it is impossible to return the set, and the necessary facilities are available, complete alignment may be carried out by following the instructions given below.

2. General Notes.

Two trimming tools are provided with each set, and these are clipped to the upper side of the R.F.Unit. The shrouded screwdriver should be used for adjusting the trimmer capacitors, and the double-ended screwdriver for the coil cores - the metal tipped end being used for the brass cores in coils L101d, L103d, L105c and L105d, and the plain end for all other variable coils. For the adjustment of the primary core of T101 on the R.F.Unit, the plain end of the screwdriver may be unscrewed.

3. In T101 on the R.F.Unit, and in T1 on the I.F.Unit, there is only one core, accessible from the underside of the chassis. In all other i.f. transformers the primary adjustments are made from the top of the chassis, and the secondary adjustments are made from the underside of the chassis.

4. A damping unit consisting of a 4.7K ohms, ¼ or ½ watt resistor, with short crocodile clip leads should be connected across the primary of T4 when the secondary is adjusted, and vice-versa, since these windings are over-coupled. No damping resistor is required when tuning any of the other i.f. transformers.

5. The signal generator used for the i.f. alignment should be set to 10 Mc/s by comparison with a crystal calibrator.

6. At all times, the output from the signal generator should be maintained at a level such that the meter of the FSM22A gives a reading of about mid-scale (0dB).

Cont'd...23

7. The cover for the R.F.Unit should be removed for i.f. alignment, but it is important that it is fitted when any adjustments are made to the r.f. circuits. Holes are provided through which the trimming tools may be inserted for alignment purposes.

8. Control Positions

CAL:	Midway Position
SET ZERO:	As given on page 10.
FINE ATTENUATOR:	25dB
AVC/MOD:	"Off"
COARSE ATTENUATOR:	"Cal"
LOUDSPEAKER ON-OFF SWITCH:	As desired
AUDIO GAIN CONTROL:	As desired
POWER UNIT SWITCH:	"On"

9. Tuning and Band Selector

For i.f. alignment these controls should be set to "30 Mc/s" and "1" respectively; for r.f. alignment, they should be set to the frequencies given in the appropriate paragraphs.

10. I.F.Alignment

Connect the signal generator, tuned exactly to 10 Mc/s, to the grid of V13. Connect the damping resistor across the primary of T4 and adjust the secondary (bottom core) for maximum meter reading. Now connect the damping resistor across the winding not being adjusted, until no further improvement is possible. The damping resistor is not required for any other adjustments.

11. Now adjust the primary and secondary of T3 for maximum meter reading, reducing the signal generator output as required.

12. Connect the signal generator to the grid of V4 (R.F.Unit) and adjust the cores of T2 for maximum meter reading. Then adjust the core of T1 (under chassis), and the core of T102 (R.F.Unit, under chassis) for maximum meter reading.

13. Connect the signal generator to the grid of V2, and adjust the cores of T101 for maximum meter reading, using the shortened trimming screwdriver for the primary core. Use the damping resistor for these adjustments (see para 10).

Cont'd...24

14. The i.f. alignment should now be complete, and checks on the i.f. bandwidth and i.f. sensitivity may be made if desired. Finally replace the R.F.Unit cover, preparatory to r.f. alignment.

15. R.F. Alignment, Additional Notes.

The signal generator should have its output impedance brought up to 75 ohms by means of a suitable series resistor. The output from the signal generator should be connected to the Aerial Socket on the FSM22A via a suitable co-axial lead and plug. The frequency calibration of the signal generator should be checked against a crystal calibrator. At all times when in use, the output from the signal generator should be maintained at a level such that the meter reading of the FSM22A is at about mid-scale (0dB).

16. The outer screen of the R.F.Unit must be in position when making adjustments to the r.f. circuits, and the appropriate trimming tool must be used; a metallic screwdriver is not suitable. It is strongly advised that the position of the spring clips used for inductance adjustment of L101e and L103e should not be changed.

17. R.F.Alignment, Procedure.

Band 1.

Adjust the signal generator, and the FSM22A TUNING and BAND SELECTOR controls to the lower tracking point of 31.5 Mc/s. Set the AERIAL TRIMMER to "5". Adjust the output from the signal generator to about 1 mV, and reduce this as necessary to maintain approximately a mid-scale reading on the FSM22A meter.

18. Adjust the core of L105a (oscillator section) until the signal is received and a maximum meter reading is obtained; reduce the signal level as required. Now adjust the cores of L103a (mixer section) and L101a (aerial section) in that order for maximum meter reading, again reducing the signal input if required. (A slight amount of "pulling" may be experienced, in which case rock the tuning control to keep the signal tuned in.)

19. Set the tuning controls of the signal generator and the FSM22A to the upper tracking point of 39 Mc/s.

Cont'd...25

20. Adjust the trimmer CT2a (oscillator section) until the signal is received and a maximum meter reading is obtained; next adjust the trimmer CT1a (mixer section) for maximum meter reading, rocking the set tuning control slightly to keep the signal accurately tuned in. Now rotate the Aerial Trimmer for maximum meter reading and note the position of this control - it should be between "3" and "7". If it is higher than "7" set it to 7 and adjust L101a (aerial section) for maximum meter reading; if lower than "3", set it to 3 and adjust L101a (aerial section) for maximum meter reading.

21. Now return to the lower tracking point (31.5 Mc/s), and repeat the procedure outlined in paragraph 18 for the oscillator and mixer sections only. Adjust the Aerial Trimmer for maximum meter reading; the position of this control should now be between "3" and "7".

22. Repeat the procedure at the upper and lower tracking points in turn until no further improvement can be obtained.

23. Finally, check that the oscillator is correctly tuned to a frequency 10 Mc/s above the signal input by applying a signal at a frequency 20 Mc/s greater than the correct frequency at each tracking point (i.e. at 51.5 Mc/s and 59 Mc/s respectively), and noting that this "image" signal is received; it will be necessary to increase the signal generator input level by 40 - 60 dB for this test.

24. Band 2

Carry out the procedure given above for Band 1 with the following exceptions.

25. The tracking points are now 43 Mc/s (lower) and 53.5 Mc/s (higher). At the lower tracking point, adjust L105b, L103b and L101b. At the higher tracking point adjust CT2b and CT1b, and if necessary L101b. Repeat the adjustments until no further improvement can be obtained.

26. The image frequencies are 63 and 73.5 Mc/s.

27. Band 3.

Carry out the procedure given above for Band 1, with the following exceptions.

Cont'd...26

28. The tracking points are now 61 Mc/s (lower) and 75 Mc/s (higher). At the lower tracking point, adjust L105c (this coil has a brass core, use the metal tipped end of the screwdriver), also adjust L103c and L101c. At the higher tracking point adjust CT2c and CT1c, and if necessary L101c. Repeat the adjustments until no further improvement can be obtained.

29. The image frequencies are 81 Mc/s and 95 Mc/s.

30. Band 4

Carry out the procedure given above for Band 1, with the following exceptions.

31. The tracking points are now 85 Mc/s (lower) and 105 Mc/s (higher). At the lower tracking point, adjust L105d, L103d and L101d (all with brass cores). At the higher tracking point, adjust CT2d and CT1d, and if necessary L101d. Repeat the adjustments until no further improvement can be obtained.

32. The image frequencies are 105 Mc/s and 125 Mc/s.

33. Band 5

Carry out the procedure given above for Band 1, with the following exceptions.

34. On this band the oscillator frequency is lower than the signal frequency, and care must be taken to adjust to the correct frequency. The tracking points are 117 Mc/s (lower) and 143 Mc/s (higher). At the lower tracking point adjust L105e (oscillator - iron dust core), but do not attempt to adjust the mixer and aerial circuits (L103e and L101e) unless the set is very badly out of alignment, since the latter are adjusted by small spring clips; in any case do not move the aerial tapping clip on L101e. At the higher tracking point, adjust CT2e and CT1e. Repeat the adjustments until no further improvement can be obtained.

35. The image frequencies are 87 Mc/s and 123 Mc/s.

36. All Bands

Quickly check at all calibration points to see that no further changes are necessary.

Cont'd...27

37. The set is now fully aligned, and sensitivity and bandwidth checks can be made.

38. R.F.Sensitivity

Set Zero as described in Section 3, para 7 (page 10).

Standardise gain, as described in Section 3, para 8 (page 10).

Set the FINE ATTENUATOR to "15dB" and note the terminal voltage required to give 0dB meter reading.

39. If the signal generator used has a 75 ohms (unterminated) output, it should be connected directly to the FSM22A; then the terminal voltage across the Aerial socket of the FSM22A is equal to the voltage indicated by the signal generator, as these signal generators are calibrated so as to give the indicated voltage into a 75 ohms load.

40. If the signal generator is one with a low output impedance, and has its output lead terminated, a suitable padding resistor must be connected in series with the output to bring the output up to 75 ohms; in this case the voltage indicated by the signal generator is the open circuit voltage and the terminal voltage applied to the FSM22A is 6dB less than that indicated.

41. Note the terminal voltage, having corrected if necessary according to the previous paragraph; express the voltage in terms of dB's above 1uV. Subtract 15dB (the FINE ATTENUATOR setting) from this figure; the resultant figure should agree with the correction factor K_v as given on the Terminal Voltage Calibration chart.

42. R.F. Noise Factor.

Set Zero as described in Section 3, para 7 (Page 10).

Standardise gain, as described in Section 3, para 8 (Page 10).

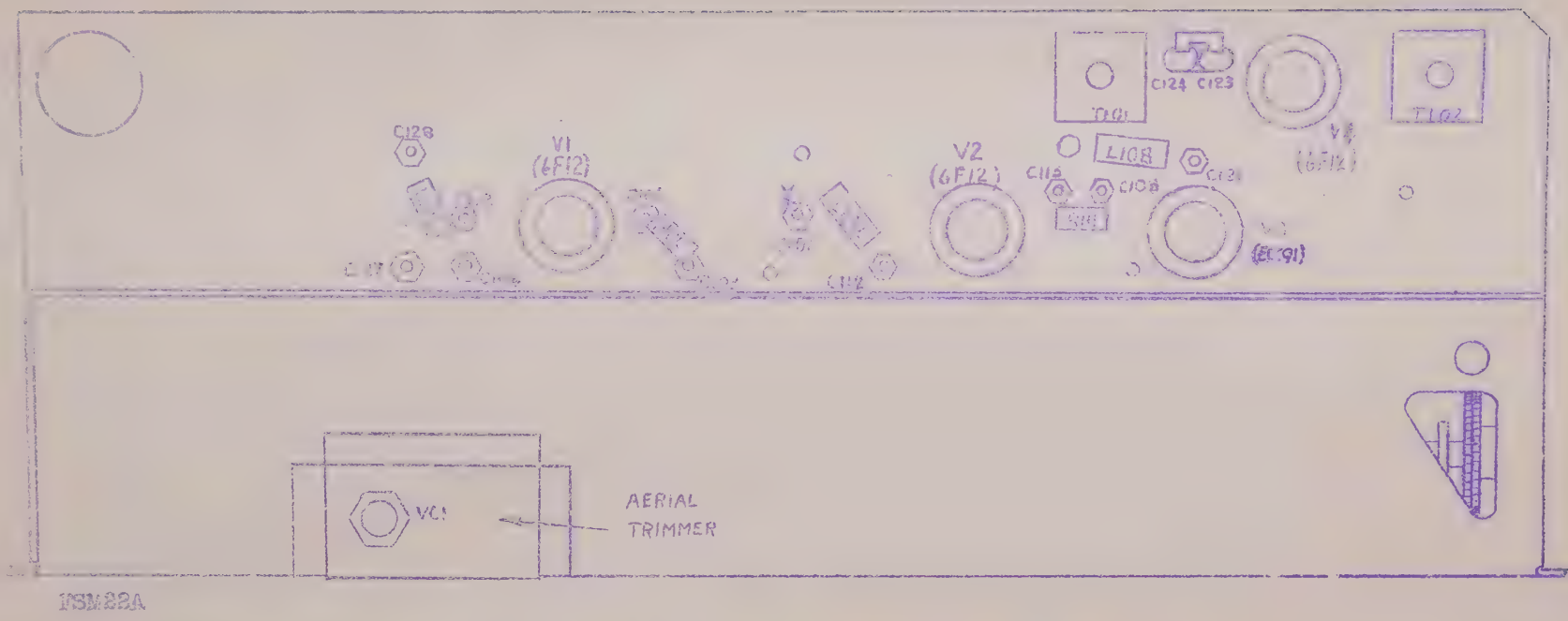
Connect a noise source of 75 ohms impedance to the Aerial socket of the FSM22A.

Cont'd...28

43. Either : Set the Fine Attenuator to 3dB and note the noise diode current (I_{dc}) in milliamps needed to bring the meter reading to 0dB; the noise factor in dB's then equals 10 $\log_{10}$ 1.5 I_{dc}.

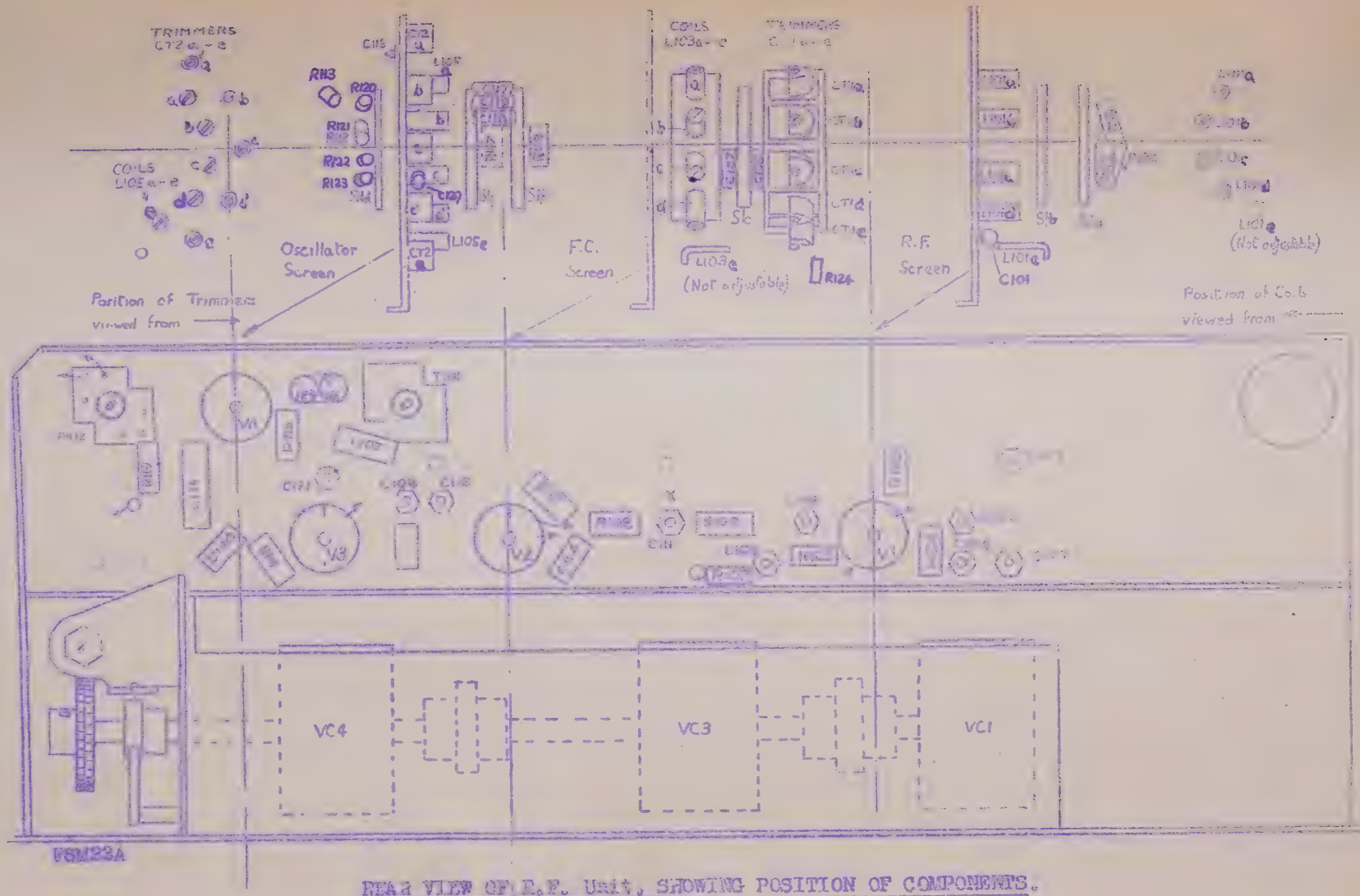
44. Alternatively ; Set the Fine Attenuator to 6dB and note the noise diode current (I_{dc}) in milliamps needed to bring the meter reading to 0dB; the noise factor in dB's then equals 10 $\log_{10}$ 0.5 I_{dc}.

45. Subtract 15.4 dB from the noise factor as found above; the resultant figure should agree with the correction factor K_v as given on the Terminal Voltage Calibration chart.



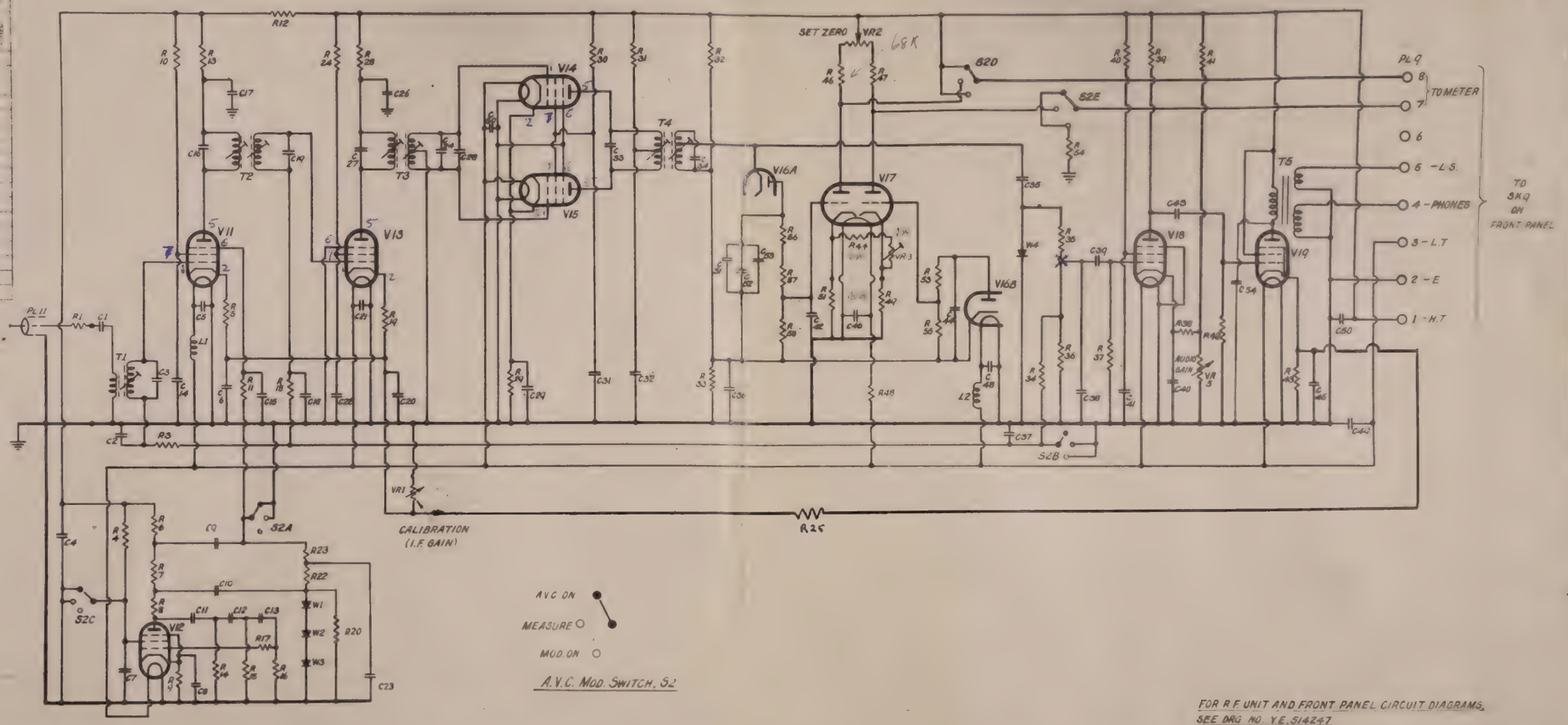
NSM88A

FRONT VIEW OF R.F. UNIT. SHOWING POSITION OF COMPONENTS.



REAR VIEW OF R.F. Unit, SHOWING POSITION OF COMPONENTS.

MURPHY RADIO LTD
WELWYN GARDEN CITY



FOR R.F. UNIT AND FRONT PANEL CIRCUIT DIAGRAMS, SEE DRG NO. Y.E. 514247

CONDENSERS

CODE	VALUE	TOL	RATING	TYPE	REF No.	DETAILS
C1	.01μF	20%	350	MET. MINICAP	DUBILIER	
C2	.01μF	20%	350	MET. MINICAP	DUBILIER	
C3	22pF	5%		N750A	ERIE	
C4	33pF	5%		N750A	ERIE	
C5	.01μF	20%	350	MET. MINICAP	DUBILIER	
C6	.01μF	20%	350	MET. MINICAP	DUBILIER	
C7	100pF	5%		N750L		
C8	.01μF	20%	350	MET. MINICAP	DUBILIER	
C9	.01μF	20%	350	MET. MINICAP	DUBILIER	
C10	.01μF	20%	350	MET. MINICAP	DUBILIER	
C11	.01μF	20%	350	MET. MINICAP	DUBILIER	
C12	33pF	5%		N750A	ERIE	
C13	.01μF	20%	350	MET. MINICAP	DUBILIER	
C14	33pF	5%		N750A	ERIE	
C15	50pF	20%		K	ERIE HIGH K	
C16	.01μF	20%	350	MET. MINICAP	DUBILIER	
C17	500pF	10%	350	.035	DUBILIER M.M.	
C18	500pF	10%	350	.035	DUBILIER M.M.	
C19	500pF	10%	350	.035	DUBILIER M.M.	
C20	100pF	20%	350	L2.2	HUNTS H35C	
C21	.01μF	20%	350	L2.2	HUNTS H35C	
C22	12μF	20%	25	CE31C	T.C.C.	
C23	12μF	20%	25	CE31C	T.C.C.	
C24	.01μF	20%	350	MET. MINICAP	DUBILIER	
C25	.01μF	20%	350	MET. MINICAP	DUBILIER	
C26	.01μF	20%	350	MET. MINICAP	DUBILIER	
C27	5-50pF	10%		CP11N	T.C.C.	
C28	100pF	5%		N750A	ERIE	
C29	.01μF	20%	350	MET. MINICAP	DUBILIER	
C30	33pF	5%		N750A	ERIE	
C31	.01μF	20%	350	MET. MINICAP	DUBILIER	
C32	500pF	20%		N	ERIE HIGH K	
C33	.01μF	20%	350	MET. MINICAP	DUBILIER	
C34	.01μF	20%	350	MET. MINICAP	DUBILIER	
C35	.01μF	20%	350	MET. MINICAP	DUBILIER	
C36	.01μF	20%	350	MET. MINICAP	DUBILIER	
C37	.01μF	20%	350	MET. MINICAP	DUBILIER	
C38	.01μF	20%	350	MET. MINICAP	DUBILIER	
C39	.01μF	20%	350	MET. MINICAP	DUBILIER	
C40	.01μF	20%	350	MET. MINICAP	DUBILIER	
C41	.005μF	5%	350	621W	DUBILIER	
C42	.01μF	5%	350	641W	DUBILIER	
C43	.01μF	5%	350	641W	DUBILIER	
C44	.01μF	20%	350	MET. MINICAP	DUBILIER	
C45	.01μF	20%	350	MET. MINICAP	DUBILIER	
C46	.01μF	20%	350	MET. MINICAP	DUBILIER	
C47	.01μF	20%	350	MET. MINICAP	DUBILIER	
C48	.01μF	20%	350	MET. MINICAP	DUBILIER	
C49	.01μF	20%	350	MET. MINICAP	DUBILIER	
C50	.01μF	20%	350	MET. MINICAP	DUBILIER	
C51	1000pF	20%		HI-KK	ERIE	
C52	.005μF	5%	350	621W	DUBILIER	
C53	.01μF	5%	350	641W	DUBILIER	
C54	.01μF	20%	350	MET. MINICAP	DUBILIER	
C55	.01μF	20%	350	MET. MINICAP	DUBILIER	
C56	33pF	5%		N750A	ERIE	
C57	50pF	20%		K	ERIE HIGH K	
C58	.01μF	20%	350	MET. MINICAP	DUBILIER	
C59	500pF	10%	350	.035	DUBILIER M.M.	
C60	500pF	10%	350	.035	DUBILIER M.M.	
C61	500pF	10%	350	.035	DUBILIER M.M.	
C62	100pF	20%	350	L2.2	HUNTS H35C	
C63	.01μF	20%	350	L2.2	HUNTS H35C	
C64	12μF	20%	25	CE31C	T.C.C.	
C65	12μF	20%	25	CE31C	T.C.C.	
C66	.01μF	20%	350	MET. MINICAP	DUBILIER	
C67	.01μF	20%	350	MET. MINICAP	DUBILIER	
C68	.01μF	20%	350	MET. MINICAP	DUBILIER	
C69	5-50pF	10%		CP11N	T.C.C.	
C70	33pF	5%		N750A	ERIE	
C71	.01μF	20%	350	MET. MINICAP	DUBILIER	
C72	50pF	20%		K	ERIE HIGH K	

RESISTORS

CODE	VALUE	TOL	RATING	TYPE	REF No.	DETAILS
R1	47	5%			Y10J	
R2	100Ω	10%			Y4	
R3	100Ω	10%			Y4	
R4	100Ω	10%			Y4	
R5	100Ω	10%			Y4	
R6	100Ω	10%			Y4	
R7	100Ω	10%			Y4	
R8	1K	10%			Y4	
R9	100K	20%			Y4	
R10	470Ω	20%			Y4	
R11	4K7	20%			Y4	
R12	100K	20%			Y4	
R13	470Ω	20%			Y4	
R14	22K	20%			Y4	
R15	33Ω	20%			Y4	
R16	10K	20%			Y4	
R17	330Ω	10%			Y4	
R18	100K	20%			Y4	
R19	100Ω	20%			Y4	
R20	100Ω	20%			Y4	
R21	100Ω	20%			Y4	
R22	180K	20%			Y4	(2P 220K) (UA 22CA)
R23	180K	20%			Y4	
R24	180K	20%			Y4	
R25	470Ω	20%			Y4	
R26						
R27						
R28						
R29	100	10%			Y4	
R30	470	20%			Y4	
R31	470	20%			Y4	
R32						
R33	1K	10%			Y4	
R34	100K	20%			Y4	
R35	180K	20%			Y4	
R36	180K	20%			Y4	
R37	180K	20%			Y4	
R38	470K	20%			Y4	
R39	330	10%			Y4	
R40	100K	20%			Y4	
R41	4K7	20%			T10	
R42	22K	10%			T10	
R43	22K	10%			T10	
R44	470	20%			Y4	
R45	4K7	20%			Y4	
R46	100K	20%			Y4	
R47	4K7	20%			Y4	
R48	100K	20%			Y4	
R49	1K	20%			Y4	
R50	22K	20%			Y4	
R51	33K	20%			Y4	
R52	1M5	20%			Y4	
R53	4K7	20%			Y4	
R54	2K2	20%			Y4	
R55	2K2	20%			Y4	
R56	2K2	20%			Y4	
R57	2K2	20%			Y4	
R58	2K2	20%			Y4	
R59	2K2	20%			Y4	
R60	2K2	20%			Y4	
R61	2K2	20%			Y4	
R62	2K2	20%			Y4	
R63	2K2	20%			Y4	
R64	2K2	20%			Y4	
R65	2K2	20%			Y4	
R66	2K2	20%			Y4	
R67	2K2	20%			Y4	
R68	2K2	20%			Y4	
R69	2K2	20%			Y4	
R70	2K2	20%			Y4	
R71	2K2	20%			Y4	
R72	2K2	20%			Y4	
R73	2K2	20%			Y4	
R74	2K2	20%			Y4	
R75	2K2	20%			Y4	
R76	2K2	20%			Y4	
R77	2K2	20%			Y4	
R78	2K2	20%			Y4	
R79	2K2	20%			Y4	
R80	2K2	20%			Y4	
R81	2K2	20%			Y4	
R82	2K2	20%			Y4	
R83	2K2	20%			Y4	
R84	2K2	20%			Y4	
R85	2K2	20%			Y4	
R86	2K2	20%			Y4	
R87	2K2	20%			Y4	
R88	2K2	20%			Y4	
R89	2K2	20%			Y4	
R90	2K2	20%			Y4	
R91	2K2	20%			Y4	
R92	2K2	20%			Y4	
R93	2K2	20%			Y4	
R94	2K2	20%			Y4	
R95	2K2	20%			Y4	
R96	2K2	20%			Y4	
R97	2K2	20%			Y4	
R98	2K2	20%			Y4	
R99	2K2	20%			Y4	
R100	2K2	20%			Y4	
R101	2K2	20%			Y4	
R102	2K2	20%			Y4	
R103	2K2	20%			Y4	
R104	2K2	20%			Y4	
R105	2K2	20%			Y4	
R106	2K2	20%			Y4	
R107	2K2	20%			Y4	
R108	2K2	20%			Y4	
R109	2K2	20%			Y4	
R110	2K2	20%			Y4	
R111	2K2	20%			Y4	
R112	2K2	20%			Y4	
R113	2K2	20%			Y4	
R114	2K2	20%			Y4	
R115	2K2	20%			Y4	
R116	2K2	20%			Y4	
R117	2K2	20%			Y4	
R118	2K2	20%			Y4	
R119	2K2	20%			Y4	
R120	2K2	20%			Y4	
R121	2K2	20%			Y4	
R122	2K2	20%			Y4	
R123	2K2	20%			Y4	
R124	2K2	20%			Y4	
R125	2K2	20%			Y4	
R126	2K2	20%			Y4	
R127	2K2	20%			Y4	
R128	2K2	20%			Y4	
R129	2K2	20%			Y4	
R130	2K2	20%			Y4	
R131	470	20%			Y4	

VALVES

CODE	DESCRIPTION	TYPE	REF No.	DETAILS
V1				
V2				
V3				
V4				
V5				
V6				
V7				
V8				
V9				
V10				
V11				
V12				
V13				
V14				
V15				
V16				
V17				
V18				
V19	AUDIO O/P	EL91	CV136	
V20	A.F. AMP	EF92	CV131	
V21	METERAMP	12AT7	CV455	
V22	DETECTOR	EB91	CV140	
V23	4TH I.F. AMP	6F12	CV138	
V24	4TH I.F. AMP	6F12	CV138	
V25	3RD I.F. AMP	EF92	CV131	
V26	AUDIO OSC.	EF92	CV131	
V27	1ST I.F. AMP	EF92	CV131	

MISCELLANEOUS

CODE	DETAILS
PL9	PAINTON MINIATURE 9-WAY
PL11	BELLING TYPE 604 P
S2	3P 5W MOD. A.V.C.
VR5	25K LOG 3001 AUDIO GAIN
VR4	
VR3	1K LINAR (METER SENS.)
VR2	15K LINAR 15350 SET ZERO
VR1	1K LINAR 10250 I.F. GAIN (CALIBRATE)
W4	B.T.H. GERMANIUM CRYSTAL C.B.4G
W3	WESTECTOR W6
W2	WESTECTOR W6
W1	WESTECTOR W6

CODE	DETAILS
L2	HEATER CHOKE
L1	HEATER CHOKE
T5	OUTPUT TRANSFORMER
T4	4TH I.F. TRANSFORMER
T3	3RD I.F. TRANSFORMER
T2	2ND I.F. TRANSFORMER
T1	1ST I.F. TRANSFORMER

USED ON

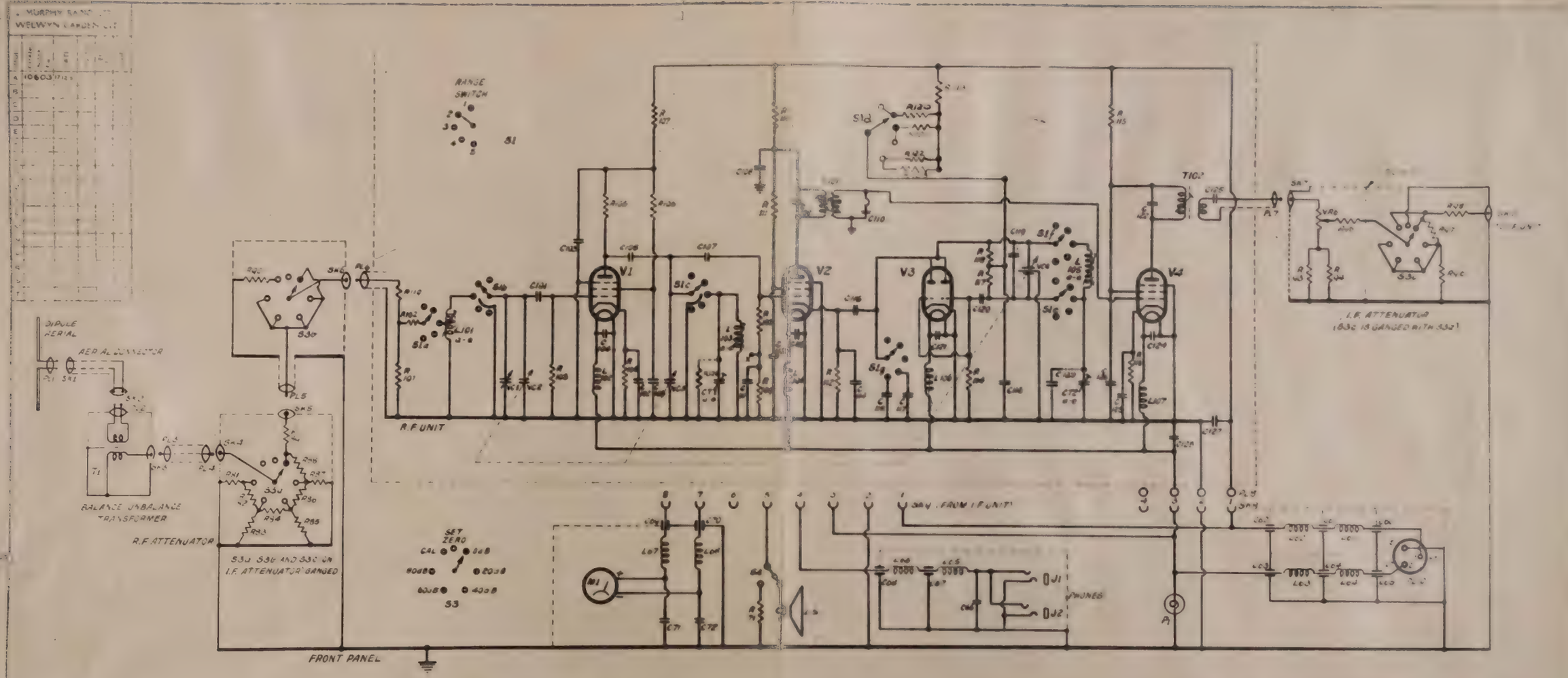
DRAWN	TRACED	CHECKED
L.M.W. 11.5.1951		

TITLE:- DIAGRAM OF CIRCUIT FOR I.F. UNIT

TYPE

REF. No. F.S.M. 22A

DRG. Y.C. 514248 A



FOR I.F. UNIT CIRCUIT DIAGRAM SEE DRAWING V.E. 514238

CONDENSERS

RESISTORS

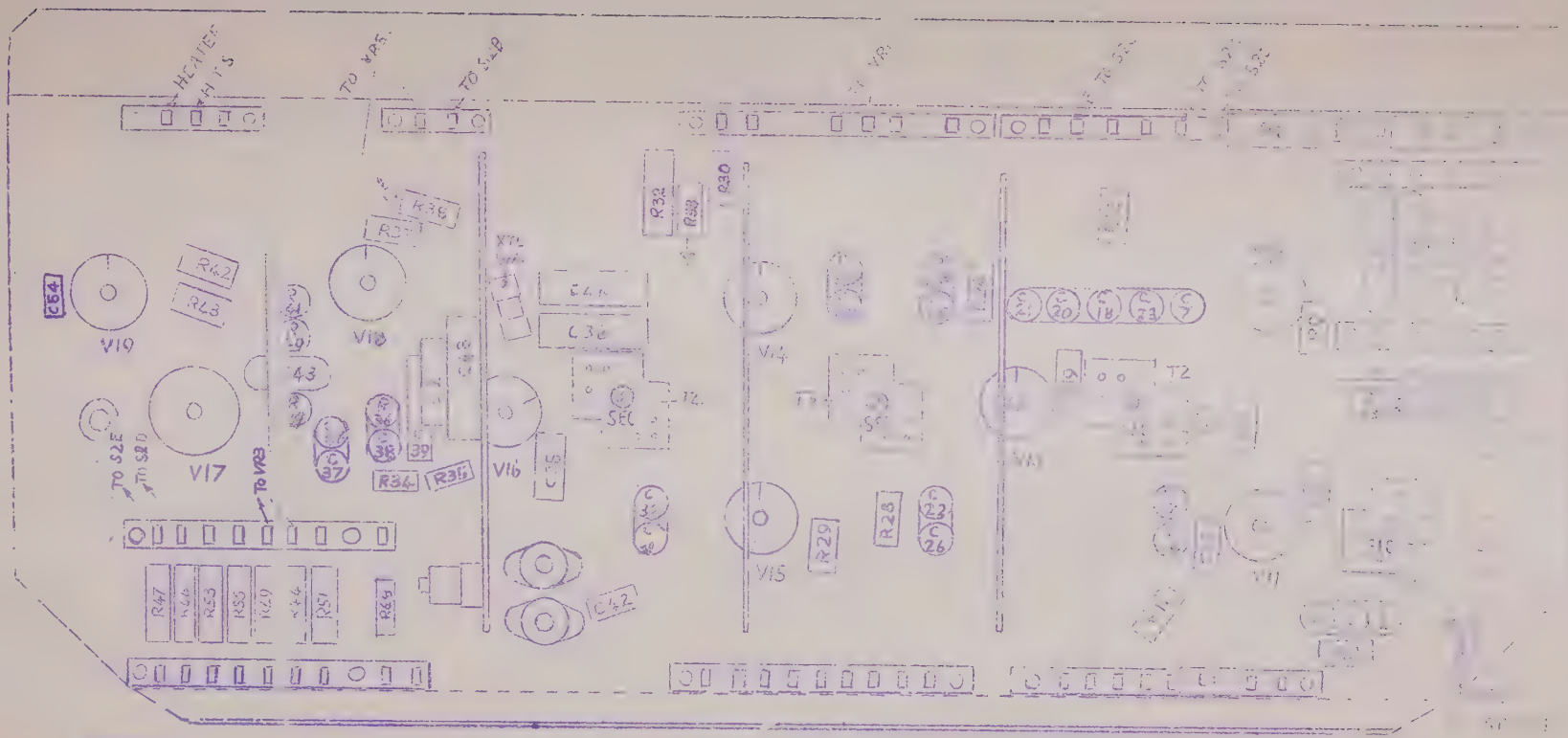
RESISTORS

VALVES

MISCELLANEOUS

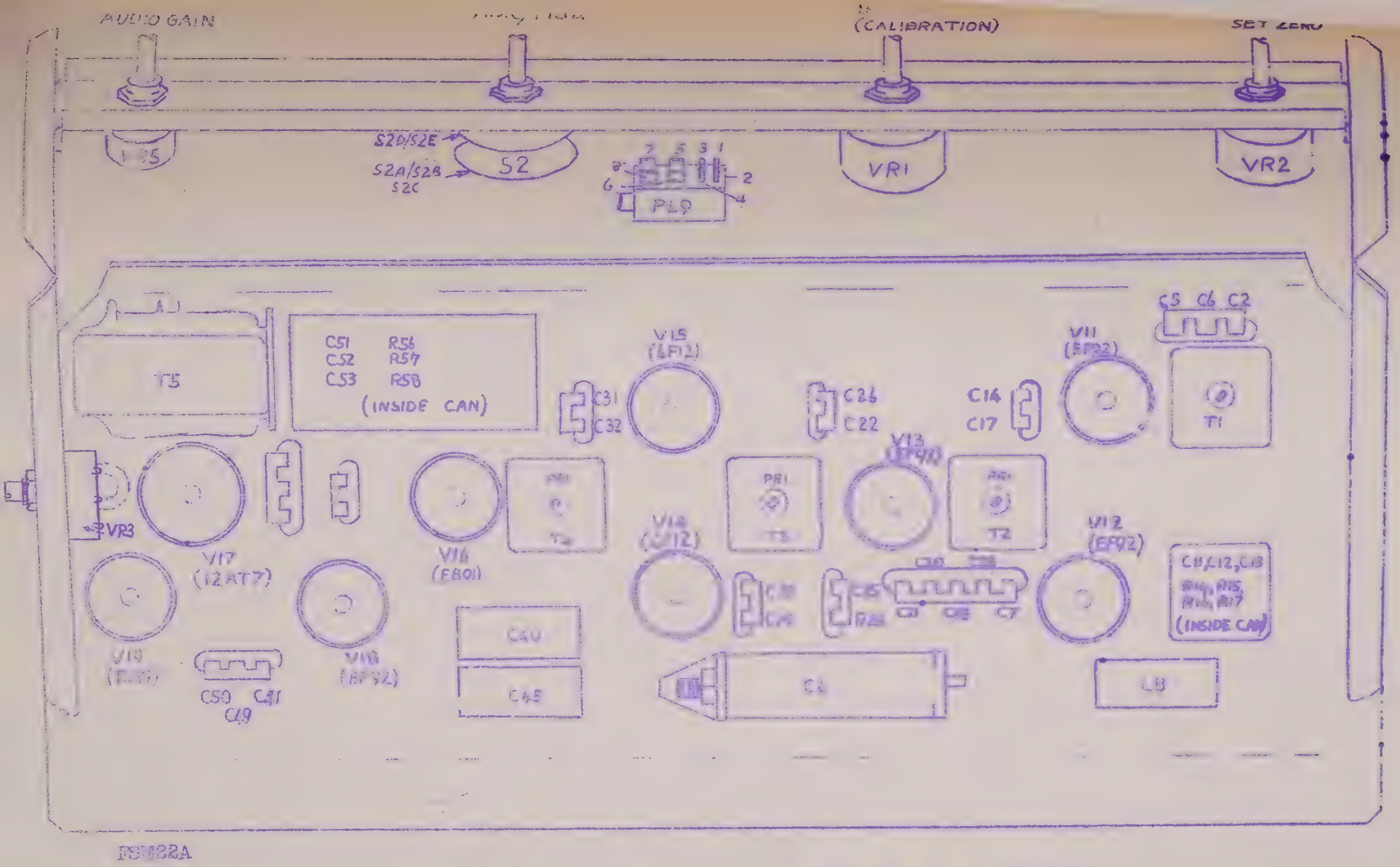
MISCELLANEOUS

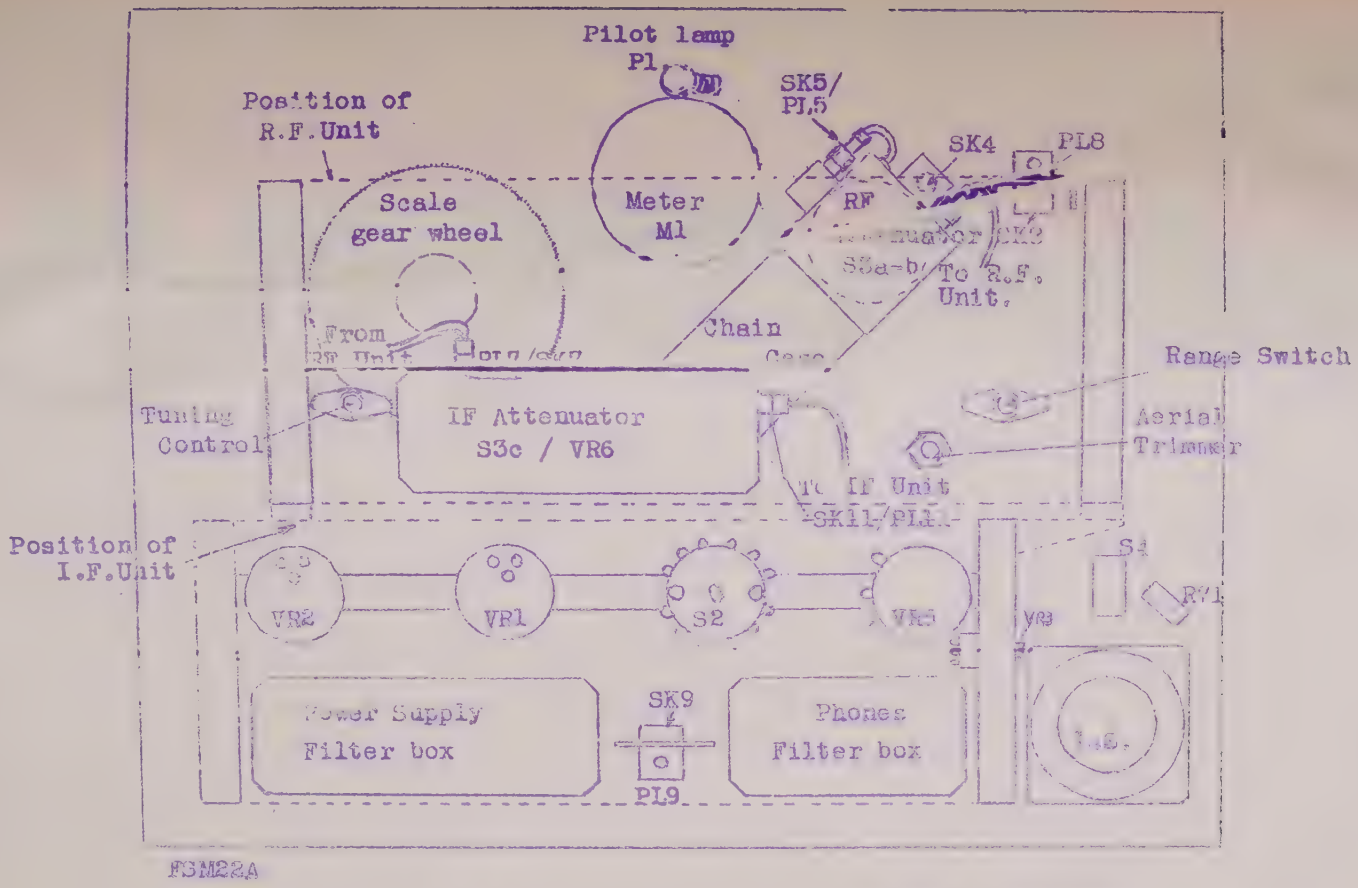
USED ON	DRAWN / TRACED / CHECKED	TITLE:- DIAGRAM OF CIRCUIT FOR FRONT PANEL & R.F. UNIT
		TYPE F.S.M. 22A REF. No.
		DRG. K.C. 514247 A



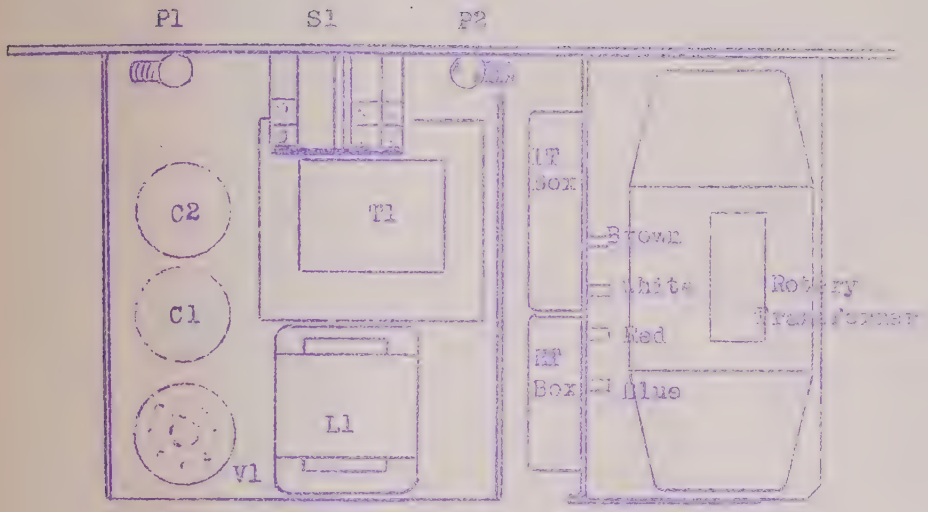
FSM22A

REAR VIEW OF I.F. UNIT, SHOWING POSITION OF COMPONENTS.

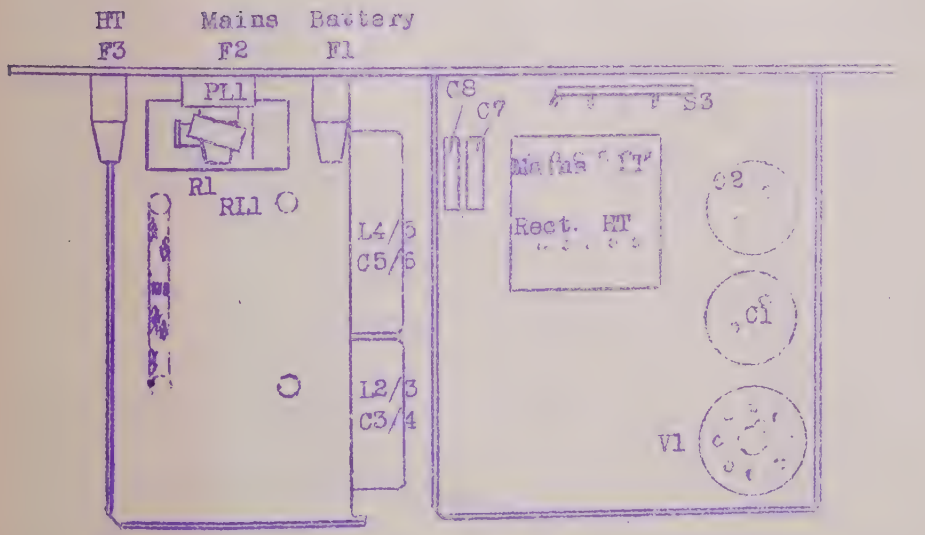

AUDIO GAIN
(CALIBRATION)
SET ZERO
S2D/S2E
S2A/S2B
S2C
S2
PL9
VR1
VR2
T5
C51 R56
C52 R57
C53 R58
(INSIDE CAN)
V15 (6F12)
C31
C32
C26
C22
C14
C17
V11 (5F32)
C5 C6 C2
T1
V13 (6F8)
VR3
V17 (12AT7)
V16 (EB91)
V16 (6J12)
PRI
T3
PRI
T4
PRI
T2
V12 (EF92)
C11,12,C13
(INSIDE CAN)
V18 (EF91)
V18 (EF92)
C50 C51
C49
C40
C45
C4
C3
C8
C7
C3
C8
C7
C3
C8
C7



REAR VIEW OF FRONT PANEL, SHOWING POSITION OF



TOP VIEW



UNDERNEATH VIEW

TOP & UNDERNEATH VIEWS OF POWER UNIT TYPE P23

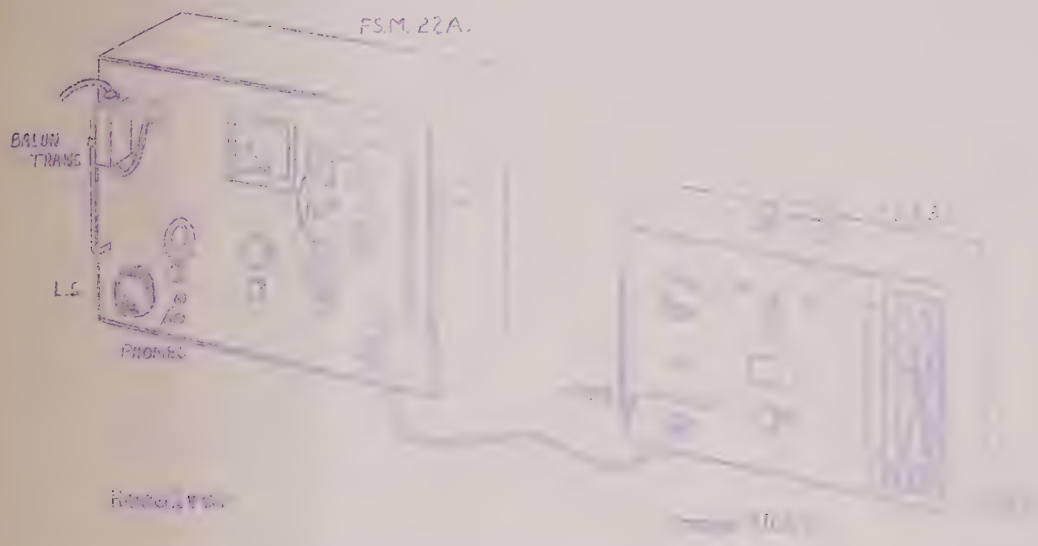


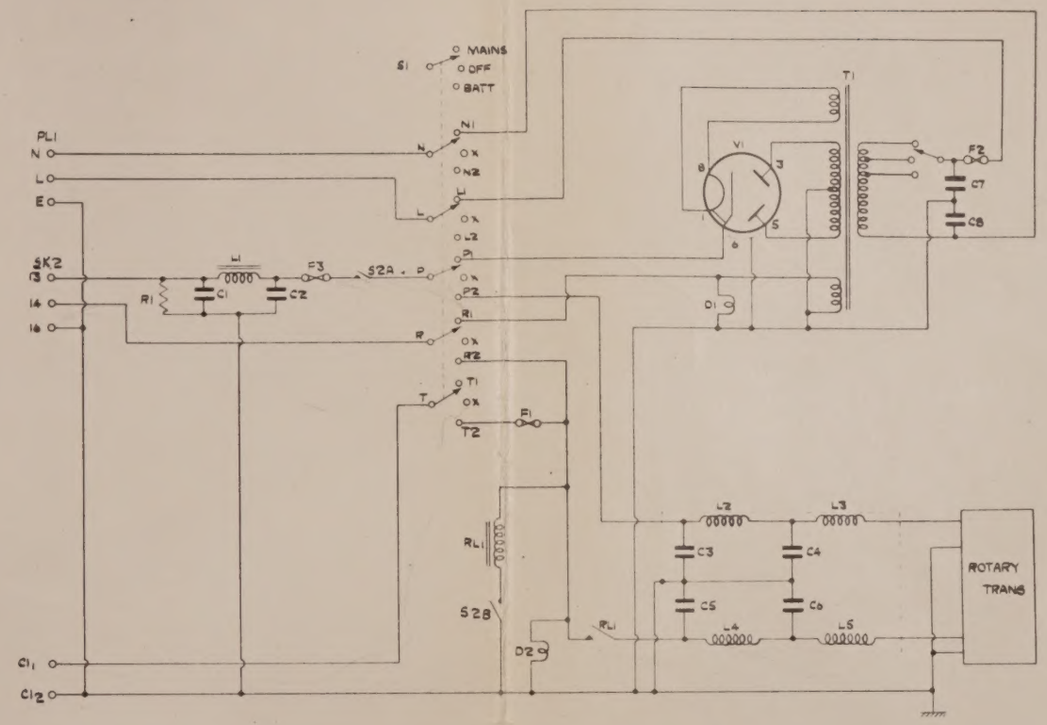
FIGURE 13. VIEW OF EQUIPMENT

REAR VIEW OF EQUIPMENT

(Covers removed)

MURPHY RADIO LTD
WELWYN GARDEN CITY

ISSUE	CHANGE NOTE No.	DATE	DRAWN	TRACED	CHECKED
A					
B					
C					
D					
E					
F					
G					
H					
J					
K					
L					
M					
N					
P					
R					
S					
T					



CONDENSERS

CODE	VALUE	TOL	D.C.W.V.	TYPE	REF. No.	DETAILS
C8	·01 μF		750 V	691N	DUB	MOULDED MICA
C7	·01 μF		750 V	691N	DUB	MOULDED MICA
C6	·75 μF		150 V	W11	HUNTS	
C5	·75 μF		150 V	W11	HUNTS	
C4	·1 μF		350 V	CP45N	T&C	
C3	·1 μF		350 V	CP45N	T&C	
C2	8+8		350V	PLESSEY	REG. DE 2015	
C1	8+8		350V	PLESSEY	REG. DE 2015	

CONDENSERS

CODE	VALUE	TOL	D.C.W.V.	TYPE	REF. No.	DETAILS
C 0						
C 9						
C 8						
C 7						
C 6						
C 5						
C 4						
C 3						
C 2						
C 1						
C 0						
C 9						
C 8						
C 7						
C 6						
C 5						
C 4						
C 3						
C 2						
C 1						

RESISTORS

CODE	VALUE	TOL	RATING	TYPE	REF. No.	DETAILS
R1	870 K	10%	Y9			

RESISTORS

CODE	VALUE	TOL	RATING	TYPE	REF. No.	DETAILS

VALVES

CODE	DESCRIPTION	TYPE	REF. No.	DETAILS
V1	UU6	MAZDA		

		ROTARY	TRANS. I/P 6V 7.8 AMP O/P 240V 0.8 AMP
			TYPE LD21, NEWTON BROS.
		T1	MAINS TRANS 4V, 6.3V, 4.5A
			250-0-250V 100ms 0-210-230-240
		D2	6V .3 AMP MES LAMP
		D1	6V .3 AMP MES LAMP
	F3	500 M AMPS	RL1 6 V RELAY WEYMOUTH GAUGE DIV. CODE RFC
	F2	2 AMPS	
	F1	2.5 AMPS	S2 DP ON/OFF BRITISH N.E.P. OUTLET HANDMADE
			LIGHT DUTY
		S1	5 CONTACT 2 WAY 4 POSITION ROTARY
			SWITCH. DIAMOND H. 78AC39 C
	L5	LT FILTER CHOKE	C12 BULLDOG CLIP (GREEN LEAD)
	L4	LT FILTER CHOKE	C11 BULLDOG CLIP (RED LEAD)
	L3	HT FILTER CHOKE	
	L2	HT FILTER CHOKE	SK2 4 WAY TONES SOCKET
	L1	10 H CHOKE 100m.a DC AP 25694 M/R1	PL1 STANDARD 3 PIN 5 AMP MAINS PLUG
	CODE	DESCRIPTION	CODE DESCRIPTION

USED ON

DRAWN DN 3451 | TRACED | CHECKED

TITLE:- DIAGRAM OF CIRCUIT FOR FIELD STRENGTH METER POWER PACK. (A) TYPE F.S.M. REF. No. 22A.

DRG. Y.E. 508664

MP MASTER
MA23732